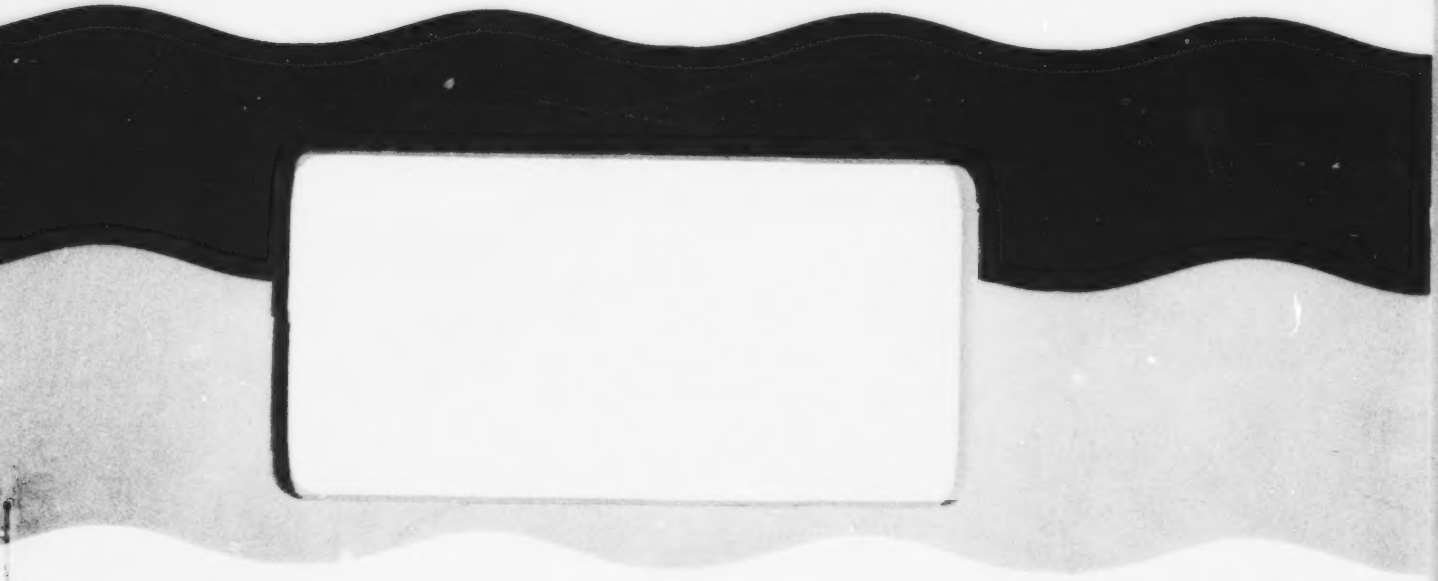
Transport Canada Transports Canada

TP 1624

Marine Casualty Investigations

Enquêtes sur les accidents maritimes



Investigation Report to the Minister pursuant to sections 542 or 545 of the Canada Shipping Act

Rapport d'investigation au Ministre conformément aux articles 542 ou 545 de la Loi sur la marine marchande du Canada

CA1
DT 70
85
R436
c.2

Canada

.CA1
DT 70
85
R436
C.2

Library and Information Centre / Centre de Documentation (GSLA)
RECEIVED - REÇU LE
OCT 25 1988
Transport Canada / Transports Canada

Ce rapport est aussi disponible en français.

REPORT OF INVESTIGATION INTO THE CIRCUMSTANCES SURROUNDING THE GROUNDING OF THE LIBERIAN VESSEL "FEDERAL ELBE" IN THE ST. LAWRENCE RIVER ON DECEMBER 28, 1985.

REPORT No. 436

These sections of the Investigation Report prepared pursuant to Section 542, or of the Preliminary Inquiry Report prepared pursuant to Section 545, of the Canada Shipping Act, are released for accident prevention purposes only and are confined to cause-related circumstances.

This report and its contents may be deficient and misleading if used in any other process and are not to be used or admitted in evidence in any legal proceedings, either civil or criminal, arising out of the casualty described in the report. The statements, opinions and findings in the report are those of the Marine Casualty Investigations Division only and do not constitute admissions made by or on behalf of Her Majesty the Queen in right of Canada.

Ces sections du rapport d'investigation ou du rapport préliminaire sont rédigées en vertu des articles 542 et 545 respectifs de la Loi sur la marine marchande du Canada et ne sont publiées qu' à des fins de prévention des accidents seulement et ne portent que sur les circonstances entourant le cas à l'étude.

Ce rapport et son contenu peuvent être insuffisants et trompeurs s'ils sont utilisés à d'autres fins et ne peuvent être utilisés ou acceptés comme preuve dans quelque procédure que ce soit, au civil ou au criminel, même si ces procédures découlent de l'accident décrit dans ledit rapport. Les déclarations, les opinions et les constatations de ce rapport appartiennent uniquement à la section des Enquêtes sur les accidents maritimes et ne constituent pas une acceptation de la part ou au nom de Sa Majesté du chef du Canada.

27856

REPORT OF INVESTIGATION INTO THE CIRCUMSTANCES SURROUNDING THE GROUNDING OF THE LIBERIAN VESSEL "FEDERAL ELBE" IN THE ST. LAWRENCE RIVER ON NOVEMBER 28, 1985.

Particulars of Vessel

Name	"FEDERAL ELBE"
Official Number	6829
Nationality	Liberian
Port of Registry	Monrovia
Call Sign	ELAD 9
Gross Tonnage	18 237
Net Tonnage	10 900
Length (overall)	199.80 m
Breadth	22.86 m
Depth	14.03 m
Built	1981, Mathias-Thesen-Werft at Wismar, German Democratic Republic
Converted	1981, Sumitomo Heavy Industries at Oppama, Japan
Type	Bulk Carrier
Propulsion	8 cylinder MAN motor, type K 8Z 70/12E, moteren Werk, Rostock, German Democratic Republic. 11 200 b.h.p. driving a controllable pitch propeller. 15 knots
Bow Thrust Propeller	Electric 1000 i.h.p.
Generators	Three (3) Diesel type 5NVU 4SA-2 built by VEB Schwermaschingebou Karl Liebknecht, Magdeberg, German Democratic Republic, 935 h.p. at 400 r.p.m., driving three (3) Garbe, Lahmeyer & Co. A.G. generators

	type DSM 800/44-18b, 450 V, 1026 A = 800 kW each at 400 r.p.m.
Emergency Generator	One (1) Danish Electric Diesels Ltd. type ON 641 driving a Newage, Stamford, England, generator type MC 3346. V, 440/254 V, 129 A Rated at 75 kW
Generator Monitoring and Control Circuits	24 V DC made by A.E.G. Steinhoft 9 200 Hamburg II Federal Republic of Germany
Control Circuit Battery Charger	V.E.B. Mathias Thesen Werft Wismar German Democratic Republic Thyristor charging rectifier with automatic controller. No. 125-2850. 60 Hz 440 V. Year of manufacture 1981
Owners	Sandaliotis Shipping Corporation Ltd. Monrovia, Liberia
Managers	Fednav Ship Management Ltd. Ibex House Minories London EC3N IDY United Kingdom
Charterers	The vessel is on time charter to: Federal Commerce & Navigation Ltd. Suite 2600 600, de la Gauchetière W. Montreal Quebec H3B 4M3
Agent	Malone Marine Agency Ltd. 2620 Notre-Dame Trois-Rivières Québec G9A 5L6
Cargo	22 875 t of zinc concentrate

Draught	On departure Trois-Rivières: F: 9.65 m A: 9.69 m M: 9.67 m
Crew	25
Classification Society	Bureau Veritas +I 3/3 E. Vracquier/Minéralier Haute-mer, Ice Class

Navigation Equipment

Radar 1	Decca RM 1626B
Radar 2	Decca ACS 1330C
Direction Finder	Plath Navigon SFP 705 LNG
Echo Sounder 1	Simrad EN
Echo Sounder 2	Simrad ED 161
Decca	Decca MK 21
Loran 'C'	Decca 1024
Sat-Nav	Magnavox MX 2102
Omega	Sait Alph-Omega OR 4600
VHF 1	Sait CB 21
VHF 2	Sait CB 20
2182 kHz	Sait Skanti TRP 600
Gyro Compasses	(2) Anshutz with 4 repeaters and supplies to navigation aids
Magnetic Compass	Reflecting W. Ludolph
Autopilot	Anshutz
Chart in Use	CHS 1336 corrected to 1985.899

Description of Vessel

The "FEDERAL ELBE" is a one deck, six-hold bulk carrier equipped with four loading cranes, each with a S.W.L. of 25 tons. Her engine and accomodation are located aft. The vessel was built in East Germany in 1981, and lengthened in Oppama, Japan, the same year. The engine is controlled for both speed and propeller pitch by an AEG bridge control system, which is operated from the central bridge console or from secondary controls situated on each bridge wing.

The vessel is on a regular trade from Europe to the St. Lawrence Seaway.

Certification at Time of Accident

All certificates were issued by Bureau Veritas, Paris, under the authority of the Government of Liberia.

1.	Load Line	Issued at Paris on November 24, 1981 Expires March 31, 1986
2.	Cargo Ship Safety Construction Certificate	Issued at Paris on October 22, 1981 Expires March 24, 1986 Last endorsed at Antwerp March 5, 1985
3.	Cargo Ship Safety Equipment Certificate	Issued at Paris on April 25, 1985, Expires March 5, 1987
4.	Cargo Ship Safety Radio Certificate	Issued at Paris, on April 25, 1985 Expires March 5, 1987

NOTE: All times in this report are expressed in Eastern Standard Time (UTC* minus 5 hours).

Background

The Liberian vessel "FEDERAL ELBE" was moored starboard side to Section 19 at Trois-Rivières, where she completed the loading of 22 875 t of zinc concentrate at 1500 on November 28, 1985.

---

*UTC - Universal Co-ordinated Time.

At 2013 the same day, the vessel had swung off the berth and was proceeding down river for Antwerp at full manoeuvring speed ahead.

When the bow thruster was not required further, one of the vessel's three main generators was shut down. Some 15 minutes later, during the vessel's transit of the St. Lawrence Seaway at a speed of about 13 knots over the ground, both her remaining generators tripped off the main switchboard. This caused a total blackout with the associated failure of her steering gear and main engine.

Shortly before 2036, when the vessel grounded in position 46°23.65'N, 72°27.43'W near buoy C39, an unsuccessful attempt was made to prevent the grounding by letting go the starboard anchor.

After initial attempts to refloat her proved unsuccessful, the vessel was lightened by discharging some 2322 t of cargo. She was eventually refloated on December 1, 1985, and after underwater inspection and temporary repairs were carried out, the vessel sailed for Antwerp at 0001, December 7, 1985.

There was no pollution or human injury as a result of the accident and marine traffic was not suspended.

Narrative

When loading was completed at 1500, November 28, 1985, all bridge navigation systems, engine controls and steering gear were tested and found to be in good order.

At about 1900 the same day, the "FEDERAL ELBE" was boarded by a pilot at Section 19, Trois-Rivières. When stand-by engine was rung at 1950, the engine was on bridge control. The vessel singled up and cast off from the quay at 2000. Both steering motors were running as were both the vessel's radars.

Employing the bow thrust propeller, the main engine and with the tug "ROBERT H" fast on the starboard quarter, the vessel was swung off the berth. At about 2010, the tug was cast off and clear and the vessel proceeded down river. At about 2013, the bridge engine control was put to about 120 r.p.m. with a propeller pitch corresponding to full manoeuvring speed ahead, about 11 knots.

On leaving Trois-Rivières, the vessel's three 800 kW/A generators were running, supplying 2400 kW/A to the main

distribution panel. On receipt of advice from the bridge that the vessel's electric bow thrust propeller was no longer required to manoeuvre, No. 1 generator was stopped at 2015.

After having swung off the berth, the vessel proceeded down river following the various leading lights and passing four upbound vessels before arriving at Cap-de-la-Madeleine. A radar position off the jetty at Cap-de-la-Madeleine was obtained by the third officer at 2030 and marked on the chart. The jetty bore 288° (T) x 1.25 cables, which placed the vessel in the middle of the channel. At this time the vessel was steering 038° (T).

Course was altered to 063° (T) at buoy C45, and to 070° (T) at buoy C41. About midway between buoy C41 and C39, a total black-out occurred at 2032. With her engine stopped, the vessel, at a speed estimated to be about 13 knots over the ground, commenced swinging slowly to starboard. The helm was ordered to hard-a-port and the engine to full astern, but neither responded. The striking of the bank forward on the vessel's starboard side was felt seconds before she ran aground at 2036.

The second officer was ordered to the steering flat to prepare the steering gear for emergency steering. He left the bridge immediately to do this, taking with him his portable radio to maintain communication with the bridge. On arrival, he switched the steering gear to the non-follow-up system in preparation for the restoration of power. As he did this he felt the vessel run aground.

On the foredeck, the chief officer was supervising the closing of hatch No. 1 when the black-out occurred. He received orders on his portable radio to let go the starboard anchor. He ordered the bosun, who was standing by the windlass on the forecastle to let go the starboard anchor. It was let go almost immediately. At about this time, the vessel ran aground.

At about 2030, in the engine-room No. 2 generator main switchboard breaker tripped and the generator's prime mover stopped. The first assistant engineer left the engine control room to restart it at the generator, succeeding in doing so at 2031. By the time he returned to the control room, the generator had again stopped. At about 2032, No. 3 generator also slowed and then stopped, tripping its breaker, thus causing a total electrical black-out which resulted in the main engine stopping.

Shortly after the black-out, the chief engineer left the engine control room for the forecastle to check on the

operation of the emergency generator. Before he arrived at the forecastle, the emergency generator was heard to start, followed almost immediately by the sound of the anchor being let go. Entering the emergency generator room under the forecastle, he pushed the button on the emergency distribution panel to engage the emergency circuit-breaker, thus supplying current to the emergency circuits.

The first assistant engineer also left the control room at the time of the black-out, and twice tried to restart No. 3 generator at the generator but was unable to do so. The motor turned on air but would not start. Shortly after this, the emergency systems and lighting came on, the power being supplied by the emergency generator. The level of the diesel oil day tank was verified and found to be correct. On checking No. 3 generator motor diesel oil line-venting screw, situated on the motor side of the fuel filter, it was found that there was no fuel in the line.

On checking the duplex strainer change-over lever at the diesel oil day service tank, it was discovered that the lever was nearly in the neutral (off) position between the two strainers, thus restricting the fuel supply to the generators. It was also found that the duplex strainers were neither dirty nor obstructed.

At 2115, the duplex oil strainer lever had been put to the forward fully open position and No. 2 and No. 3 generator fuel lines had been cleared of air. No. 3 generator was started at the generator and an attempt made to engage its breaker employing the 24 V DC automatic generator protection and switch-over system. The breaker failed to engage. At 2116, it was found that there was no power to the 24 V automatic control panel. At 2117, No. 2 generator was started and run up and its breaker on the main distribution panel was manually closed, thus restoring power to the vessel.

Between 2045 and 2120, all cofferdams, bilges, ballast tanks, fuel tanks, and diesel oil tanks were sounded. The soundings revealed that there was no ingress of water, and there was no change in fuel or diesel tank levels. Soundings round the vessel were also obtained and these indicated a least depth of 7.90 m on the port bow. The vessel was found to be aground on her starboard side from forward to the after end of No. 5 hold, and on her port side from forward to the after end of No. 3 hold.

The accident was reported to VTS Montreal on VHF channel 13 at 2044. During the black-out the radio continued to operate on batteries. The contents of the message indicated

that the vessel was partly in the channel as about 50 m of her length were protruding into it. The vessel was reported to be heading 079.5° (T).

Efforts to refloat the vessel by her own power were commenced about 2325 and abandoned at 2330. Tugs were ordered for the next morning at the high water period.

At 0955 the next morning, November 29, 1985, three tugs, the "CAPTAIN IOANNIS S" of 7000 h.p., the "LEONARD W" of 4200 h.p., and the "ROBERT H" of 1000 h.p. arrived alongside the vessel. By 1100, the tugs were made fast, and using the engine on full astern with the tugs in various combinations, efforts to refloat the vessel were continued until 1235, when these were abandoned. The tugs were let go at 1240 and dismissed at 1410. On completion of the effort to refloat the vessel, the ship's head was 097° (T).

A computerized stability and loading condition programme for the vessel is on file at Lloyd's of London. After a disposition of cargo, fuel, etc., had been communicated to them, a lightening plan designed not to stress the vessel was generated by the computer. A similar programme was also worked on the vessel's LOADICATOR by the chief officer.

At 2230, access to No. 1 port ballast tank was gained through a manhole from the fore-peak when it was discovered that there was an indent 1200 mm x 500 mm x 150 mm approx. in the ship's bottom plating in way of frames 193 to 196. A weld in the indent was found to be fractured over a length of 200 mm and weeping. No difficulty was experienced in keeping the tank dry by occasional use of the ballast pump.

Barge "P.S.1" arrived alongside the vessel at 0545 on November 30, 1985. After rigging grabs to the ship's cranes and, following the calculations made in London and on board, lightening operations commenced in No. 1 hold at 0945. Lightening continued from holds 1, 2, 4 and 5 until 1350 on December 1, 1985. During this time tanks 1.1, 1.4, 1.5, 1.6, and 1.7 were ballasted to maintain the vessel's position aground in the current. A total of 2232 t of cargo were discharged to the barge.

At 1130 on December 1, 1985, tug "CAPTAIN IOANNIS S", 7000 h.p., was made fast aft and tug "SALAVAGE MONARCH", 1400 h.p., was made fast on the port quarter. The vessel's engine was put on stand-by at 1230 when deballasting was commenced. At 1250 tug "CATHY MCALLISTER", 1200 h.p., and tug "HELEN MCALLISTER", 1320 h.p., were made fast on the port bow and starboard quarter, respectively. Using her main engine astern while deballasting, and assisted by the four tugs, the

vessel came afloat at 1415.

The tugs were let go at 1445 and the vessel proceeded to an anchorage at Bécancour. Reloading of cargo from the barge commenced at 1640, December 1, 1985 and was completed at 0830 on December 4, 1985.

During reloading, the vessel was inspected by the acting port warden, Trois-Rivières, who granted permission for the vessel to proceed to Baie Comeau for underwater inspection and repair. She sailed from Bécancour at 0948 on December 4, 1985.

At Baie Comeau, divers inspected the vessel and carried out repairs consisting of an exterior bolted plate and gasket over the arrested cracked weld in way of frame 195 and an interior cement box. The temporary repairs were completed in the afternoon of December 6, 1985, to the satisfaction of Bureau Veritas and Ship Safety surveyors.

The vessel sailed for Antwerp at 0001 on December 7, 1985.

Analysis

1. Weather and Tidal Conditions

Weather conditions at the time of the casualty were:

Wind	NW at 10 knots
Barometer	1023 mbs
Air temp.	-6° C
Sea temp.	-0° C
Sky	Cloudy
Visibility	Good

The average rate of current in the vicinity of the position in which the vessel grounded is shown on CHS chart No. 1336 as being 060° (T) x 1.7 knots. The Sailing Directions, Gulf and River St. Lawrence, sixth edition, 1985 state:

> "Tidal and Current Information - The tidal influence at Trois-Rivières is very small; the maximum rise and fall of the tide is about 1 foot (0.3 m).
>
> Near the downstream limit of Trois-Rivières Harbour, NE of

Pointe de Bécancour, the river current sets to the east at a rate of 1.5 knots..."

High water times at Trois-Rivières for the period during which the vessel was aground were:

November 28, 1985	1254
November 29, 1985	0049 and 1329
November 30, 1985	0124 and 1404
December 1, 1985	0204 and 1439.

2. **Generator Fuel System**

Diesel fuel for the vessel's generators is carried in tank No. 5.1. It is transferred from the tank through a separator to the diesel oil day tank. From the day tank the diesel passes through a fuel shut-off valve which may be closed by remote control from outside the machinery space.

On the generator side of the day tank shut-off valve, fuel passes through a duplex strainer. Either strainer may be in service depending on the position of a strainer change-over valve, the control lever for which is in the fully open position at approximately 45° on either side of the vertical.

The end of the lever, which is not weighted to hold it in the open position, is situated about 7 cm outboard of, and 30 cm above, the edge of the catwalk at the diesel oil day tank.

Between the fully open position and the vertical, movement of the lever will progressively reduce the amount of fuel flowing to the strainer in service until the lever is in the fully vertical position. In this position the valve is closed, and the fuel supply to both strainers, and consequently the generators, is completely cut off.

From the strainer in service, fuel is fed to all three generator prime movers which are situated on a lower level in the engine-room. At each generator prime mover is a mechanically driven diesel oil gear pump which raises the fuel to a duplex fuel filter housing each containing a paper filter element. The duplex fuel filter is situated at the fore top end of the generator prime mover. It is equipped with an air bleeder valve on top of the filter. A fuel by-pass valve is fitted to the fuel line on the gear pump to allow the filter in

service to be primed by gravity.

When the generators blacked-out, fuel supply to the filters by the gear pumps was cut off.

When attempts were made to restart the generators after the black-out, the first assistant engineer omitted to change over the by-pass valve to prime the fuel system. It was for this reason that there was no fuel at the filters. The error was discovered at 2115, by which time the fuel lines had been cleared of air.

After the black-out occurred, it was reported that the duplex fuel strainer change-over lever was in a near vertical position, a position in which fuel flow to all three generators may have been restricted.

How the lever came to be in this position and under what circumstances were not determined.

Since the accident a protective cage has been built between the catwalk and the lever to prevent the lever being accidentally moved.

3. **Tests Carried Out on Fuel Systems**

Tests were carried out when the vessel was at anchor in Bécancour on December 3, 1985, in an attempt to simulate the black-out. The lever to the fuel strainers was shut causing the generators to stop. After this test, the paper filters were removed from their housings at each generator for the first time since the black-out. Under normal conditions, diesel fuel from the day tank passes through the filters from the outside of the filter element towards the centre.

The filters at No. 2 and No. 3 generators were found to be heavily contaminated with sludge, and had collapsed in their housings. The filter at No. 1 generator, which had been voluntarily shut down some 17 minutes before the black-out was also crushed and contaminated, but to a lesser extent.

Samples of sludge taken from the filters were sent to the fuel analysis laboratory of Det Norske Veritas in Norway. The sludge was found to contain ash products, base metals and calcium.

Before the state of the filters was known, the generators were run for five days with the collapsed filters in place in their housings.

The generators in service at the time of the black-out were those at which the filters were more severely damaged, and as the fuel lines at these generators contained only air immediately after the black-out, it is possible that the filters collapsed as a result of partial fuel starvation while the generators were running.

It would also appear clear that the filters in themselves did not cause the fuel starvation as the generators were run for five days with the filters in place.

There was no evidence to suggest that the remote control day tank fuel shut-off valve had been operated.

4. **Description of Generator Monitoring and Control System**

The electric generating plant of the "FEDERAL ELBE" is, under normal conditions, operated automatically. If, for any reason, a generator stops when on load, a preselected stand-by generator will be started up automatically and run up to speed. Its breaker will then close and the stand-by generator will come on load.

This sequence is controlled by a 24 V DC circuit, the power for which is supplied by two 12 V lead acid batteries connected in series. These batteries are kept charged to 24 V by an automatic battery charger rated at 10.5 A with a maximum charging capacity of 15 A. The breaker of the stand-by generator is activated through a relay by the 24 V DC circuit.

A feature of the circuit is its fail-safe capability. An electrical fault will cause the breaker(s) of the generator(s) to trip, but the generator prime mover(s) will continue to run. If, however, a generator prime mover stops because it has developed a fault, it will not restart automatically as the generator would have been shut down by the system described below. In this case a generator prime mover must be restarted at the generator, run up to speed (400 r.p.m.), and the breaker on the main distribution panel closed manually.

At the time of the accident, No. 1 generator was on stand-by and it failed to start when the black-out occurred.

The 24 V DC circuit monitors the generator prime mover for three abnormal conditions: low oil pressure, high cooling water temperature and overspeed.

Each generator prime mover is equipped with a mechanically driven tachometer which supplies a voltage directly proportional to the number of revolutions turned. It is fed to a printed circuit board for the relevant generator where it is compared to a standard 24 V DC which is supplied by the same batteries referred to above.

When a generator prime mover is in an overspeed condition, the voltage supplied by the tachometer to the sensing circuit will exceed the voltage generated by the tachometer at the generator prime mover's predetermined speed of 400 r.p.m.

If the pre-set differential between the constant reference voltage supplied by the batteries and the voltage supplied by the tachometer is exceeded for a pre-set time (a few seconds), the sensing circuit will determine this difference, will close a relay which will switch the battery voltage to a fuel cut off solenoid on the generator prime mover and shut it down. At the same time the circuit will sound an alarm and indicate an overspeed condition on the engine-room control panel.

The sensing circuit is programmed to detect a voltage differential between the voltage supplied to it by the generator tachometer and the battery reference voltage only. If the standard reference battery voltage were to fall below the pre-set tolerance, the voltage differential at which the overspeed shut down sequence occurs would take place, even though the generator prime mover was turning at normal revolutions.

Verification of the 24 V DC protection and control system after the black-out revealed that its battery voltage had fallen below 15 V. Further checks carried out on the system showed that the automatic battery charger had developed a fault and had not been charging the batteries.

Because of the evidence concerning the possible fuel starvation described in Point 3 of the Analysis and the complexity of the electronic control system, it was not fully appreciated at this time that low battery voltage had caused the generators to shut down. However, the batteries were changed and repairs to the battery charger were carried out after the grounding.

A similar black-out occurred on January 14, 1986, when the vessel was alongside Section 43 at Montreal. Battery control voltage was then found to be about 15 V.

The possibility that the two black-outs were caused by low battery voltage was thoroughly investigated by a specialist. It was discovered that the battery charger had developed an intermittent fault in automatic mode.

Tests were carried out to simulate the black-out of November 28, 1985. A low battery voltage was artificially induced to the control circuit under the same conditions and the same sequence of events that happened at the time of the grounding, re-occurred. The experiment was repeated at least 10 times with the same result.

The fuel cut-off solenoid on No. 2 generator prime mover was activated by the control circuit, the alarm sounded, the overspeed indicator light on the engine room alarm panel lit, and the generator shut down, tripping its breaker on the main distribution panel. No. 3 generator shut down after the same sequence about a minute later, causing a total black-out. No. 1 stand-by generator did not automatically start up to come on load.

That No. 3 generator did not shut down until about one minute after No. 2 generator is considered to be due to a slight difference in the pre-set voltage differential on its printed control circuit.

Voltage on the control circuit was found to have dropped below 15 V after No. 2 generator had shut down and it continued to fall off rapidly. At this point it was insufficient to initiate the starting sequence at No. 1 generator.

The above experiment was repeated twice for the investigating officer on January 24, 1986, again with identical results.

It was discovered during the above simulations that the overspeed shut-down sequence due to low control voltage occurred only when the control voltage fell below its 24 V. Under operating conditions this would be due to the battery charger undercharging.

In this condition the control voltage will fall slowly enough to stay within the reference zone on the time delay component of the printed circuit to activate the shut-down sequence.

If however the control voltage was quickly cut off, the shut-down sequence was not found to occur.

Since the above was discovered, a new battery charger has been installed and the 24 V control and protection system modified. Changes were also made to the alarm system.

The control system has been modified by fitting a metre with high and low alarm settings. In the modified system, when the control voltage drops to 21 V on the battery side, a local alarm will sound and a warning light will come on. At the same time the metre will operate a relay which will open the three battery standard voltage circuits for the generators. The sequence will prevent the generators from blacking out after an erroneously indicated overspeed condition due to low control voltage.

Once the control voltage is cut off, the main alarm system will signal a 24 V DC failure. The main alarm is then relayed to whichever U.M.S. (unmanned machinery space) terminal in the engineer's cabin is in use.

5. Emergency generator

The emergency generator of the "FEDERAL ELBE" is situated under the forecastle in the emergency generator room. It is rated at 75 kW at 440 V. In the event of a black-out the generator prime mover will start and run up automatically; however, the power generated will not supply the emergency generator distribution panel until its main breaker is manually engaged. The emergency generator supplies the following to the 440 V systems:

- fan for the CO2 room
- bridge desk 620
- 2 fans
- charging rectifier
- smoke detection
- transformers Nos. 3 and 4
- engine-room exhaust fans
- auxiliary air compressor
- welding plant
- cooling water heat-exchanger pump
- emergency fire pump
- harbour salt water pump
- air compressor forward

The emergency generator also supplies the following 220 V systems:

- steering gear control
- emergency lighting - emergency generator room

- emergency lighting - engine room
- emergency lighting - general
- engine-room control desk

If all the above systems are disconnected from the emergency power distribution panel, it is theoretically possible to start and run one electric-hydraulic steering motor from the emergency generator. In practice, however, the surge in power in starting up the electric-hydraulic steering motor is greater than the 75 kW rating of the emergency generator, and would have caused the emergency generator breaker to trip. The emergency system is not in fact designed to run the motor, and no attempt was made to do so after the black-out.

The 220 V steering gear circuit from the emergency generator is to supply power for the transmission of helm orders to the electric-hydraulic steering only, and will not operate the 440 V electric-hydraulic steering gear motor.

The vessel was completed and converted in 1981. At that time she was required to comply with the emergency generator provisions of Regulations 26 (d) paras. (i) to (v) inclusive of the International Conference on Safety of Life at Sea 1974 (Annex 1).

These provisions require neither that the emergency generator start automatically nor that the power generated be supplied automatically to the required circuits.

Further the Regulations do not require that the power be supplied to the steering gear motors by the emergency generator.

6. Qualifications and Experience of Personnel

The master of the "FEDERAL ELBE" is the holder of current Korean and Liberian Ocean-going Master's Licences. He has 13 years of seagoing experience of which 7 are as Master. The vessel is a regular trader on the Europe - St. Lawrence Seaway route.

The chief officer of the "FEDERAL ELBE" is the holder of a current Korean Master's Licence for vessels under 6000 GRT, and a current Liberian first mate's Licence for a vessel of any tonnage. He has 10 years of seagoing experience of which 3 are as chief officer.

The second officer of the "FEDERAL ELBE" is the holder of a current Korean Master's Licence for vessels under 6000 GRT, and a current Liberian second mate's Licence for a vessel of any tonnage. He has 2 years of experience as a navigating officer in the Korean Navy and 3 years experience as an officer in Merchant ships.

The third officer of the "FEDERAL ELBE" is the holder of a current Korean Master's Licence for vessels under 6000 GRT, and a current Liberian third mate's Licence for a vessel of any tonnage. He has 2 years of experience as third officer.

The chief engineer of the "FEDERAL ELBE" is the holder of a current Korean Chief Engineer's Licence, Steam and Motor, both for a vessel of any horsepower. He has 16 years of seagoing experience of which 10 are as chief engineer and has been a chief engineer aboard this vessel for a total of more than a year.

The second engineer of the "FEDERAL ELBE" is the holder of a current Korean Chief Engineer's Licence (combined) and a current Liberian first engineer's Licence, Steam and Motor, both for a vessel of any horsepower. He has 7 years of seagoing experience of which 2 1/2 are as first assistant engineer.

The pilot of the "FEDERAL ELBE" is the holder of a Class "A" pilot's Licence issued by the Laurentian Pilotage Authority in 1985. He has 5 years experience as a pilot in the sector Québec-Trois-Rivières after an apprenticeship of 2 1/2 years.

Findings

It would appear that the "FEDERAL ELBE" ran aground after having suffered a total electrical black-out as a result of:

- a malfunction in her DC generator automatic protection and control 24 V DC system which successively shut down her generators and thus her main engine and steering gear;

It would also appear that:

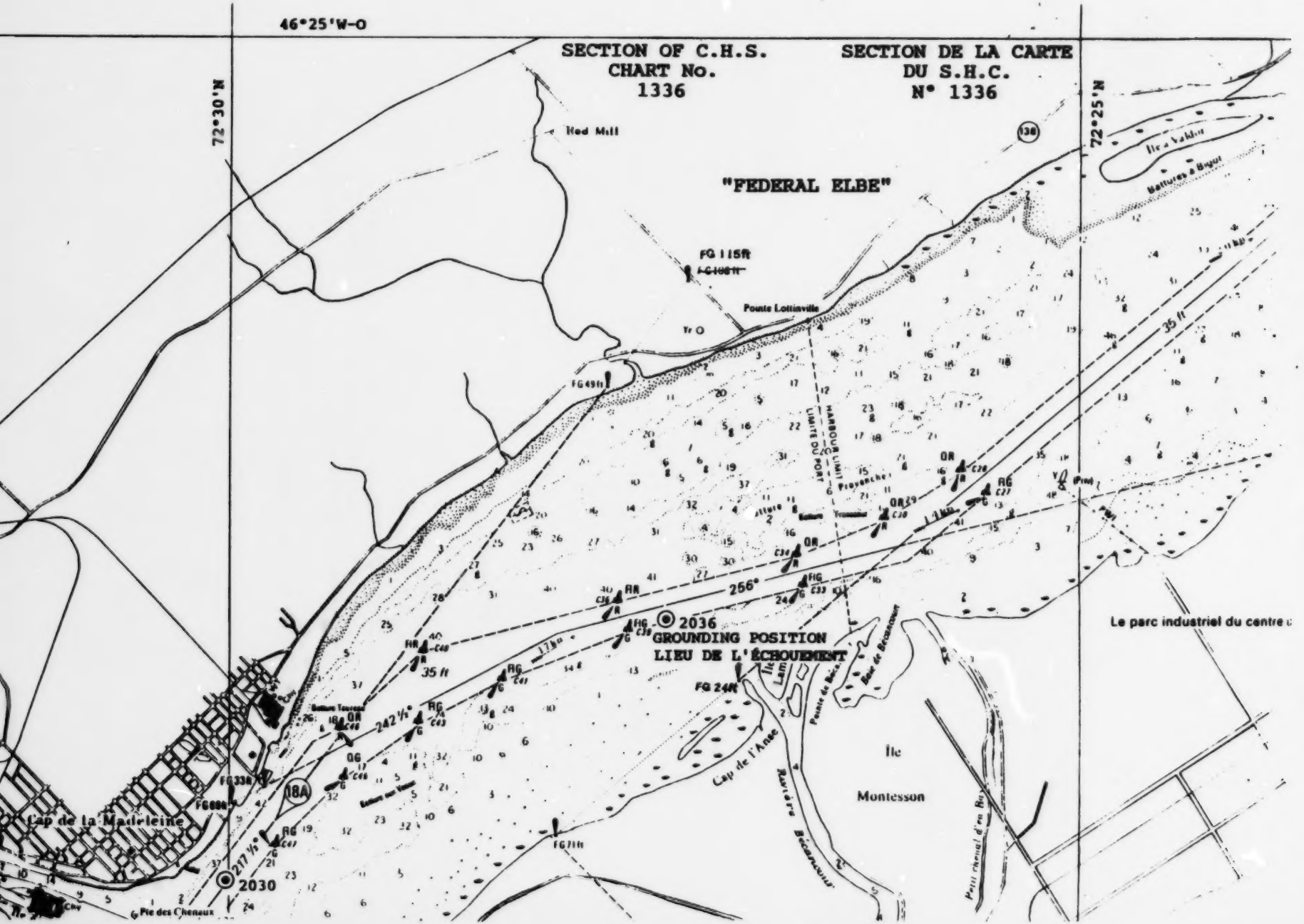
- the malfunction was brought about as the result of a low control voltage in her generator overspeed sensing system, which was in turn caused by a defective battery charger;

- the protection and control system contained a design fault in that it was not able to distinguish between a low control voltage and a generator overspeed condition;

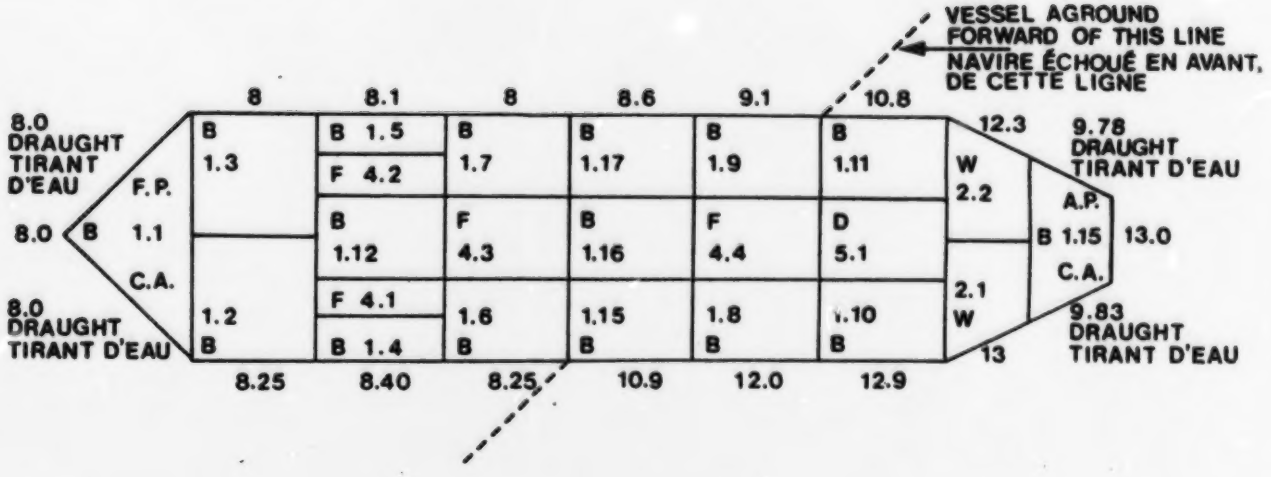
- there were pollutants in the diesel fuel supply to the generators which contaminated the generator fuel filters, although this condition probably did not contribute to the black-out; and

- the vessel's emergency generator functioned as it was required to do by the applicable SOLAS Regulations of 1974.

OTTAWA, ONTARIO
OCTOBER, 1986.


46°25'W-O
SECTION OF C.H.S.
CHART No.
1336
SECTION DE LA CARTE
DU S.H.C.
N° 1336
72°30'N
72°25'N
"FEDERAL ELBE"
Red Mill
Pointe Lotinville
FG 115ft
FG 49ft
FG 71ft
FG 24ft
FG 33ft
FG 89ft
HARBOUR LIMIT
LIMITE DU PORT
35 ft
256°
242½°
217½°
2036
GROUNDING POSITION
LIEU DE L'ÉCHOUEMENT
2030
18A
Cap de l'Anse
Île
Montesson
Le parc industriel du centre
Pte des Cheneaux

"FEDERAL ELBE"



1. BALLAST (B)
   LEST
2. FRESH WATER (W)
   EAU DOUCE
3. FUEL OIL (F)
   MAZOUT
4. DIESEL OIL (D)
   HUILE DIESEL

SAILING DRAUGHT IN TROIS-RIVIÈRES
TIRANT D'EAU DE DÉPART DE TROIS-RIVIÈRES

SKETCH SHOWING
CROQUIS DÉMONTRANT

1. TANK LAYOUT
   L'AGENCEMENT DES CITERNES
2. SOUNDINGS AROUND VESSEL AT THE TIME OF GROUNDING
   LES SONDES AUTOUR DU NAVIRE LORS DE L'ÉCHOUEMENT
   ~~LA PARTIE DU NAVIRE ÉCHOUÉ~~
3. SECTION OF THE VESSEL THAT WAS AGROUND
   LA PARTIE DU NAVIRE ÉCHOUÉ

ANNEX 1

International Conference on Safety of Life at Sea 1974

Regulation 26

"Emergency Source of Electrical Power in Cargo Ships

(a) Cargo ships of 5,000 Tons Gross Tonnage and upwards

(i) In cargo ships of 5,000 tons gross tonnage and upwards there shall be a self-contained emergency source of power, located to the satisfaction of the Administration above the uppermost continuous deck and outside the machinery casings, to ensure its functioning in the event of fire or other casualty causing failure to the main electrical installation.

(ii) The power available shall be sufficient to supply all those services which are, in the opinion of the Administration, necessary for the safety of all on board in an emergency, due regard being paid to such services as may have to be operated simultaneously. Special consideration shall be given to:

(1) emergency lighting at every boat station on deck and oversides, in all alleyways, stairways and exists, in the main machinery space and main generating set space, on the navigating bridge and in the chartroom;

(2) the general alarm; and

(3) navigation lights if solely electric, and the daylight signalling lamp if operated by the main source of electrical power.

The power shall be adequate for a period of 6 hours.

(iii) The emergency source of power may be either:

(1) an accumulator (storage) battery capable of carrying the emergency load without recharging or excessive voltage drop; or

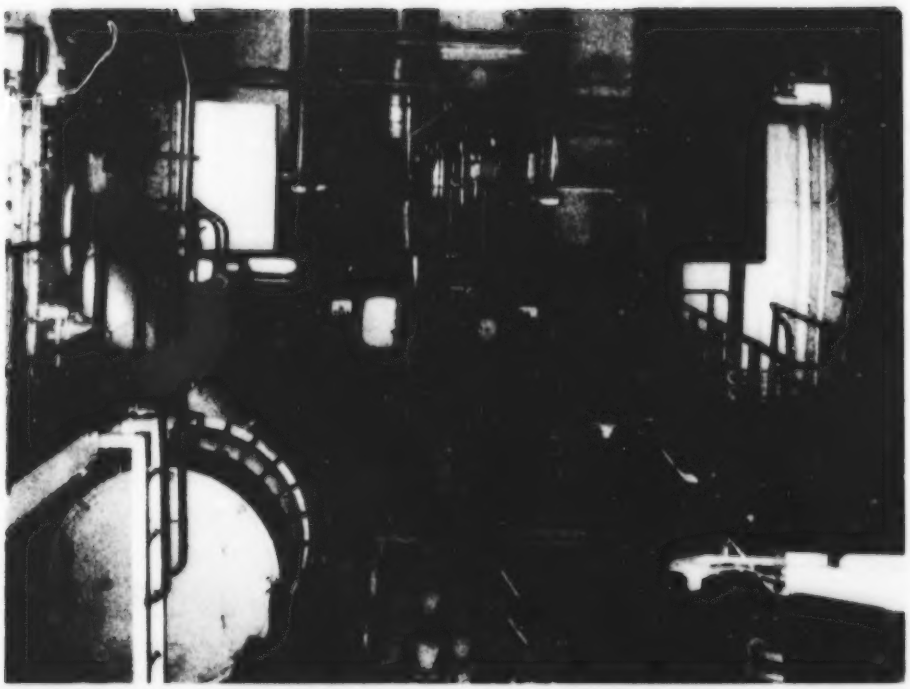
(2) a generator driven by a suitable prime-mover with an independent fuel supply and with starting arrangements to the satisfaction

of the Administration. The fuel used shall have a flashpoint of not less than 43° C (110° F).

(iv) Arrangements shall be such that the complete emergency installation will function when the ship is inclined 22 1/2 degrees and/or when the trim of the ship is 10 degrees.

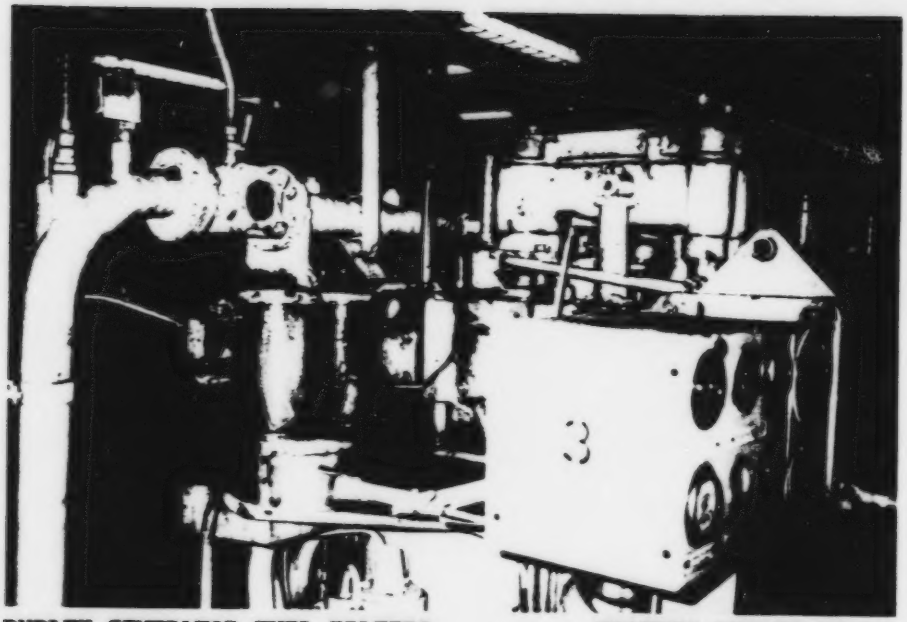
(v) Provision shall be made for the periodic testing of the complete emergency installation."

PHOTOGRAPHS PHOTOGRAPHIES



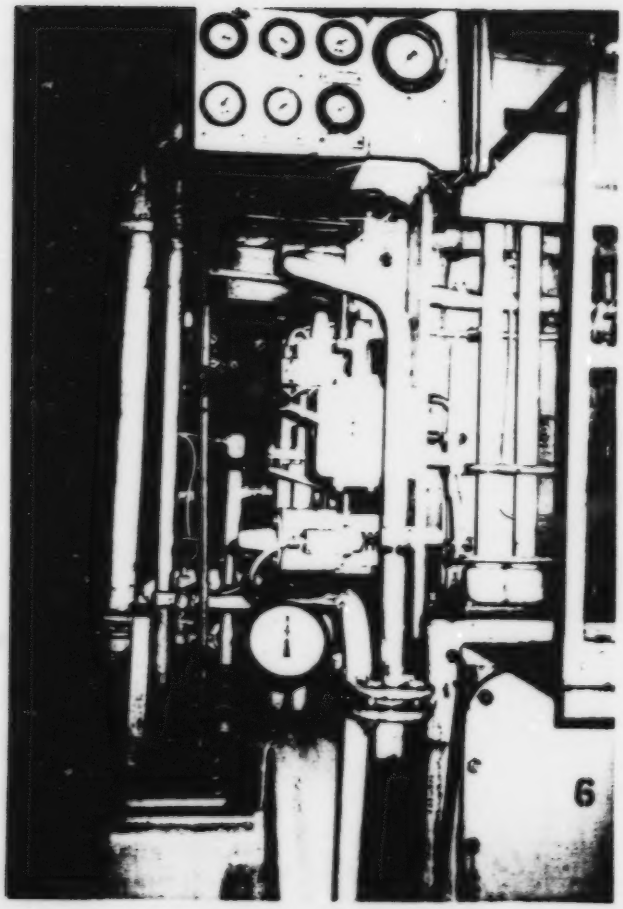
ENGINE ROOM LAYOUT, LOOKING AFT.
No. 2 GENERATOR AT CENTRE

DISPOSITION DE LA SALLE DES MACHINES VUE VERS L'ARRIÈRE
GÉNÉRATRICE N°2 AU CENTRE



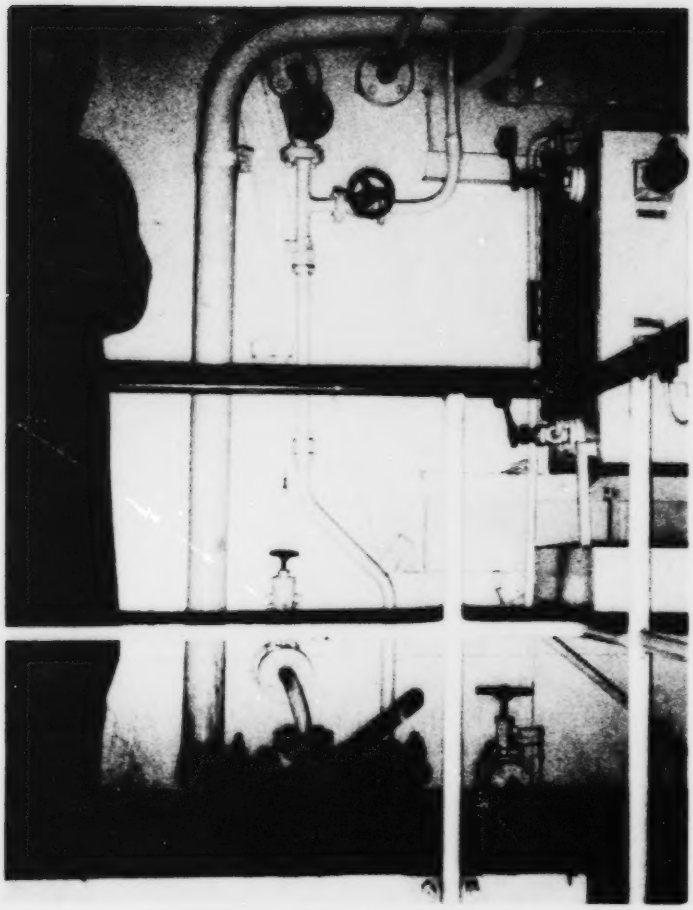
DUPLEX GENERATOR FUEL FILTERS

FILTRES DUPLEX DE LA GÉNÉRATRICE



LEFT:
FUEL CUT-OFF SOLENOID
ON GENERATOR

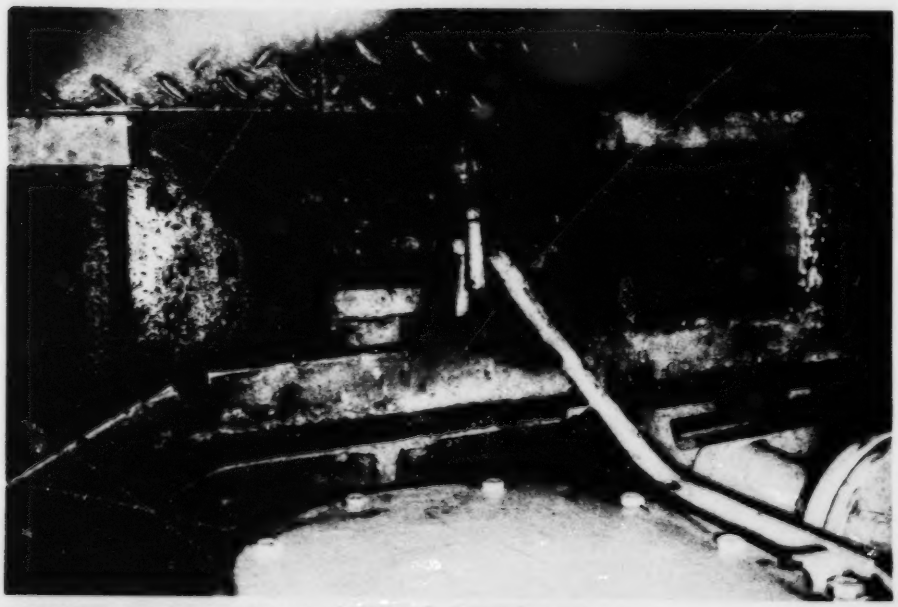
À GAUCHE:
VALVE SOLÉNOÏDE
DE FERMETURE
DU CARBURANT
À LA GÉNÉRATRICE



LEFT:
DUPLEX OIL STRAINER
CATWALK

À GAUCHE:
CRÉPINE DUPLEX DE
L'HUILE ET PASSAVANT

GEAR PUMP FUEL BY-PASS VALVE AT GENERATOR

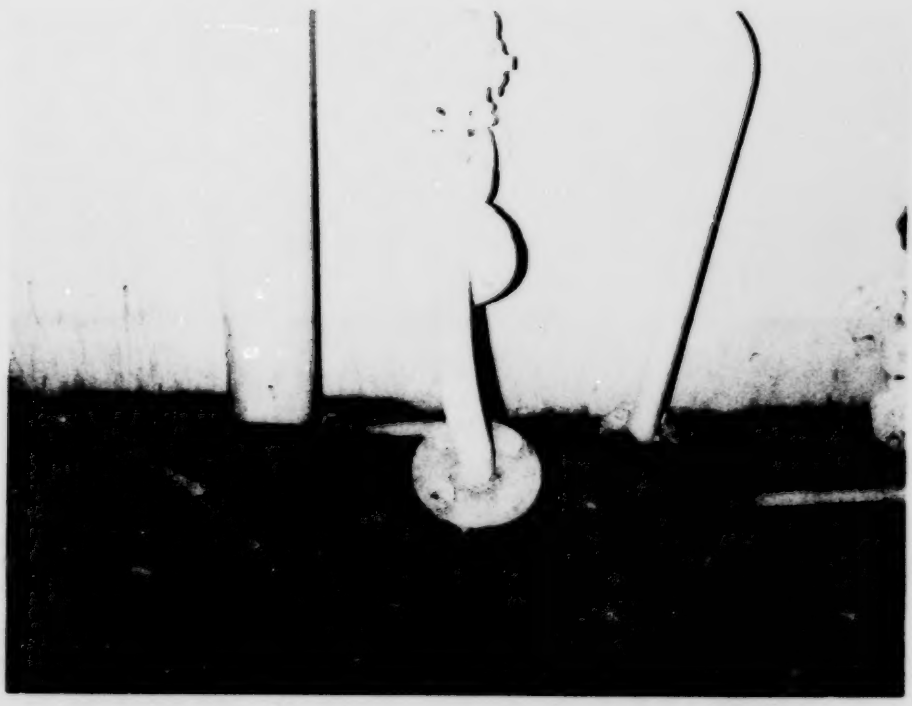


ROBINET BY-PASS DE LA POMPE À ENGRENAGE
POUR COMBUSTIBLE PRÈS DE LA GÉNÉRATRICE

LEFT:
DUPLEX OIL STRAINER AND REMOTE CONTROL SHUT-OFF VALVE. NOTE EDGE OF CATWALK.

À GAUCHE:
CRÉPINE DUPLEX DE L'HUILE ET COMMANDE À DISTANCE DE LA SOUPAPE D'ARRÊT. À REMARQUER LE BORD DU PASSAVANT.

RIGHT:
DUPLEX OIL STRAINER. LEVER IN FORWARD FULLY OPEN POSITION.



À DROITE:
CRÉPINE DUPLEX DE L'HUILE. BRAS DE LÉVIER À LA POSITION PLEIN FLUX.